EXPT NO. NAME

LAB – 01

+ Objective II : Design a ckt. with an AC source, series RLC branch

(1) Now, $X_L = R$

∴ We have taken $R = 100\ \Omega$

$\therefore\ X_L = 100\ \Omega$

$2\pi f L = 100\ \Omega$

For $F = 50Hz$; $L = \frac{100}{314}$

$\therefore\ \boxed{L = 0.3185\ H}$

→ ~~Circuit~~ For circuit P.T.O.

(2) Display shows RMS current as $\boxed{1.593A}$

~~Measurement~~ : 10 second after switch on,

$\therefore$ instantaneous current $= \boxed{-1.5A}$

∴ $Z = 100 + (j)\ 100$

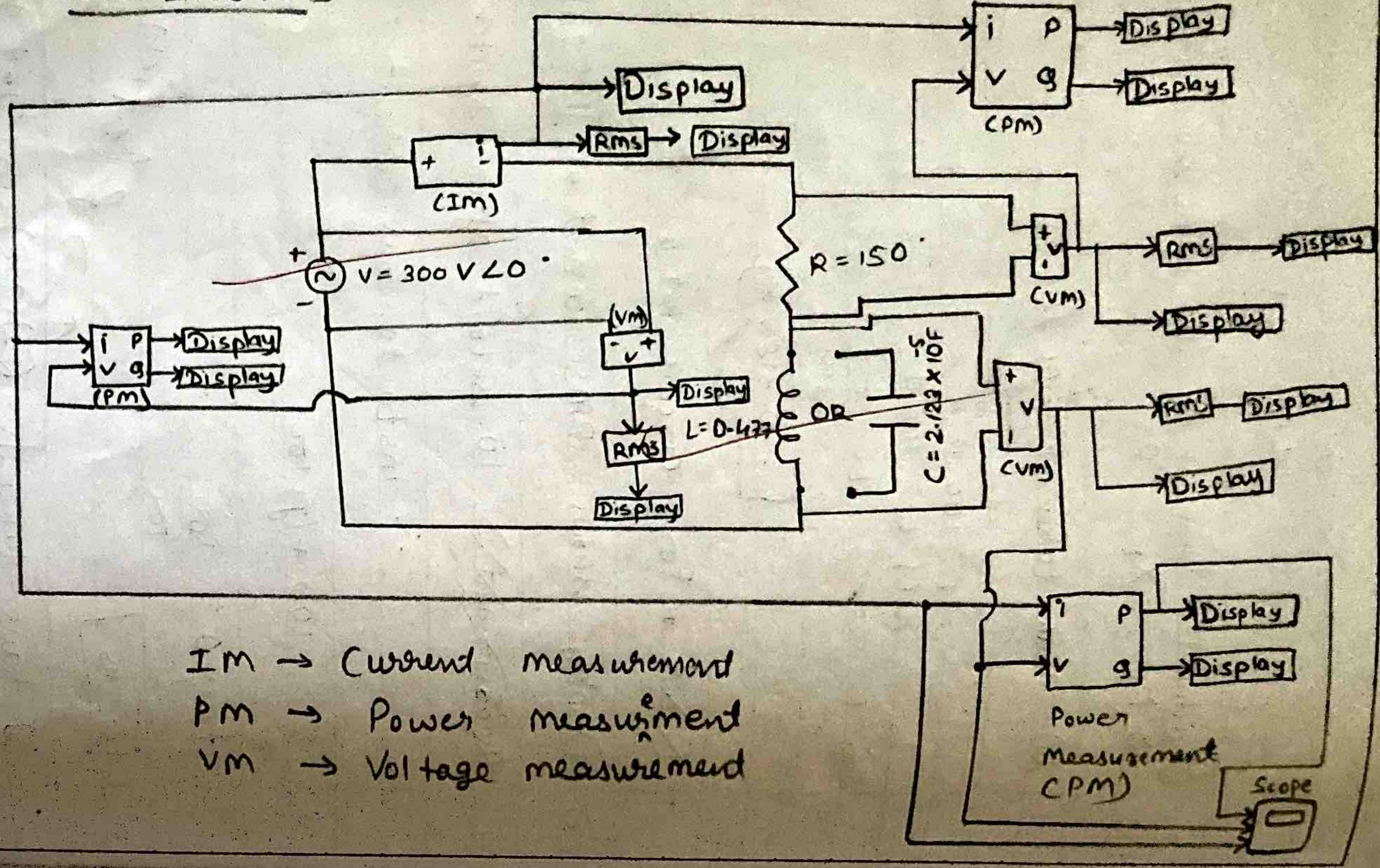
∴ $\tan\theta = \frac{100}{100}$

$\boxed{\theta = 45^\circ}$

relation

$\therefore$ We have taken: $\boxed{V = (\sqrt{2})(218)\cos(314t)\ V}$ and $\boxed{V_p = 300V}$

CONTINUOUS



IM → Current measurement

PM → Power measurement

VM → Voltage measurement

EXPT. NO. | NAME

Q3) → Instantaneous voltage across AC source from display (after) 10 seconds = 4×10^{-11} V

→ RMS value of voltage from display = $\boxed{218\ \text{V}}$

→ Instantaneous voltage across resistor from display after 10 seconds of switch ON = $\boxed{-150\ \text{V}}$

→ RMS value of voltage across resistance from display = $\boxed{1593}$

→ Instantaneous voltage across inductor from display after 10 seconds of switch ON = $\boxed{150\ \text{V}}$

→ RMS value of voltage across inductor from display = $\boxed{139.3}$

Q4) Power displayed across AC source :-

$\boxed{P = 233.3\ \text{Watt}}$

$\boxed{Q = 224.9\ \text{VAR}}$

Power displayed across Resistor :-

$\boxed{P = 235.1\ \text{Watt}}$

$\boxed{Q = 1.232 \times 10^{-11}\ \text{VAR}}$

Power displayed across Inductor :-

$\boxed{P = -1.796\ \text{Watt}}$

$\boxed{Q = 224.9\ \text{VAR}}$

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OBSERVATIONS :

(5)

R (Ω)	L (H)	V_R (V)	$V_{R(RMS)}$ (V)	V_L (V)	$V_{L(RMS)}$ (V)	P_{RP} (Watt)	P_{RQ} (VAR)	P_{LP} (Watt)	P_{LQ} (VAR)	I_{rms} (A)	V_{AC} (V)	$V_{AC(RMS)}$ (V)
100	0.3185	-150	159	150	139.5	235.1	1.292×10^{-11}	-1.796	224.9	1.59	4×10^{-11}	217.8
50	0.159	-149.9	159.6	149.9	139.1	465.8	-5.534×10^{-11}	6.448	449.9	3.191	4×10^{-11}	220.2
150	0.477	-150	160.2	150	138.5	156.3	-1.002×10^{-11}	1.476	150	1.068	4×10^{-11}	220.5

→ Values displayed after 10 second of switch ON of the circuit. at $V_p = 300V$

R → Resistance

L → Inductance

V_R → Voltage across Resistor (Instanteneous)

$V_{R(RMS)}$ → Voltage across Resistor (RMS)

P_{RP} → Real power across Resistor

P_{RQ} → Reactive power across Resistor

$V_{AC(RMS)}$ → Voltage across AC source (RMS)

V_L → Voltage across inductor - (Instanteneous)

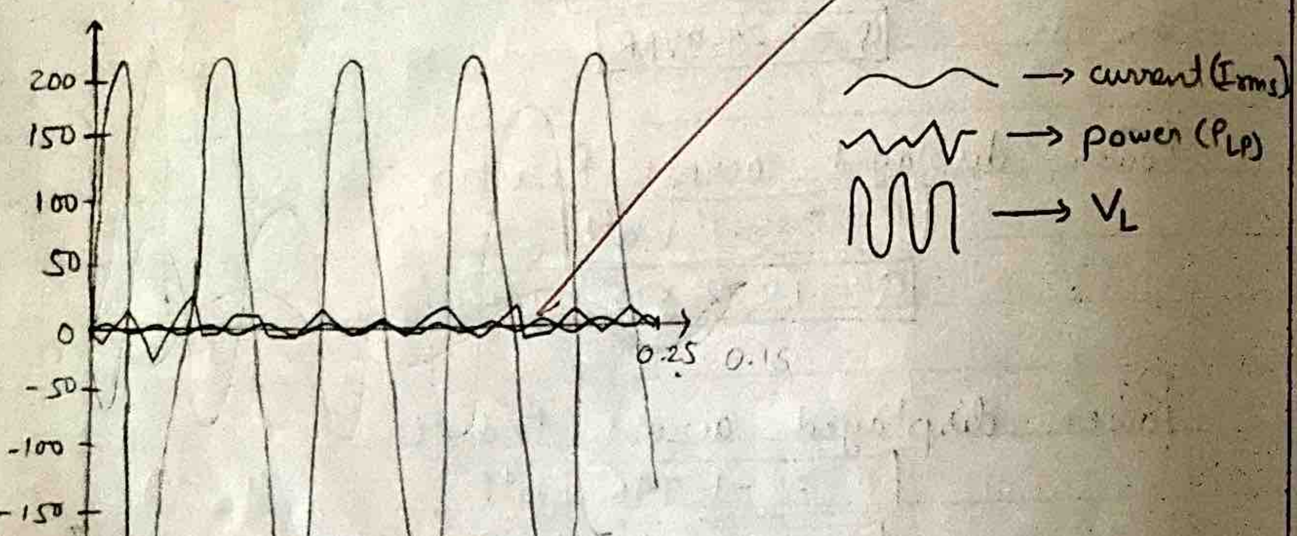
$V_{L(RMS)}$ → Voltage across inductor - (RMS).

P_{LP} → Real Power across inductor

P_{LQ} → Reactive Power across inductor

V_{AC} → Voltage across AC source - (Instanteneous)

6) Scope Observation from 0 - 0.15 seconds. of V_L, P_{LP}, $I_{(rms)}$:-



EXPT. NO.	NAME

Q7] $X_C = R$

$\therefore X_C = 150\,\Omega$

$\therefore \frac{1}{2\pi f C} = 150\,\Omega$

$\therefore C = \frac{1}{(2)(\pi)(50)(150)}$

$= \frac{1}{(314)(50)}$

$= \boxed{2.123 \times 10^{-5}\ F}$

Q8]

R (Ω)	C (F)	V_R (V)	$V_{R(RMS)}$ (V)	V_C (V)	$V_{C(rms)}$ (V)	P_{RP} (Watt)	P_{RQ} (VAR)	P_{CP} (Watt)	P_{CQ} (VAR)	I_{rms} (A)	V_{AC} (V)	$V_{AC(rms)}$ (V)
150	2.123×10^{-5}	0.03163	216.8	-0.03163	0.02185	313.2	-4.619×10^{-14}	0.0047	-0.0314	1.445	1.029×10^{-12}	216.8

→ Displayed values after 10 seconds.

→ We can see V_C instanteneous is negative, as voltage lags in capacitive load.

→ For waveform P.T.O.

Q9] Difference between RL and RC circuit :-

→ The Voltage across capacitor is nearly 0 while across inductor, it's a significant number.

→ Also instanteneous voltage across ~~is~~ capacitor is negative and nearly 0 while in inductor it's positive and also significant.

P.T.O.

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→ The voltage across Resistor in RL circuit is significant while
instantaneous
in RC circuit in RC circuit it is nearly equal to zero as
instantaneous voltage across capacitor is nearly zero.

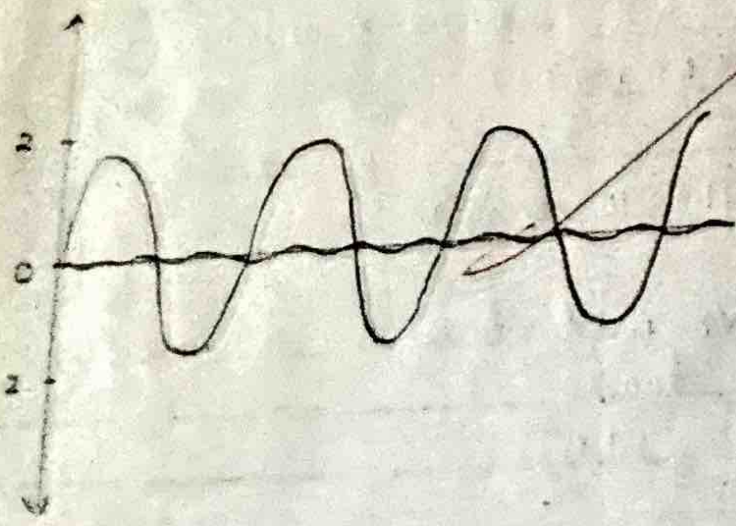
→ The reactive power in RL circuit ~~is significant~~ across Inductor is significant while reactive power in RC circuit across capacitor is nearly zero.

→ Similarities ~~or differences~~ between RL and RC ckt.:-

→ V_{Rms} across AC source in both RL and RC ckt is similar.

→ Also I_{Rms} in both RL and RC ckt is similar.

Q8




→ I in RC circuit

$P_{CP} \approx V_C(t) \approx 0$;:—

EXPT. NO. NAME

LAB-02 (Graph at the End)

* **Objective**: 3-ϕ AC circuit & Y-connected RLC branch-analysis

→ I_{rms} (Ph-A) = 1.405 A

→ V_{rms} (Ph-A) = 155.6 V

→ P_{rms} (Ph-A) = 175.1 W

→ Q_{rms} (Ph-A) = 66.83 VAR

→ $V_{LL\,(rms)}$ (Ph A-B) = 269.4 V

→ R = 100 Ω

→ So $X_L = 100\,\Omega$

$\therefore L = \frac{X_L}{\omega} \approx \boxed{0.3185\ H}$

Sr. No.	R(Ω)	L(H)	V_{AB} (V) (RMS)	Single phase (RMS)				Three Phase (RMS)	
				$V_{A\phi}$ (V)	$I_{A\phi}$ (A)	$P_{A\phi}$ (W)	$Q_{A\phi}$ (VAR)	$P_{3\phi}$ (W)	$Q_{3\phi}$ (VAR)
1	100	0.3185	269.4	155.6	1.405	175.1	66.83	7.021	0
2	200	0.637	269.4	155.6	0.9056	105	15.94	3.51	0
3	300	0.9555	269.4	155.6	0.7618	81.69	-1.022	2.34	0

P.T.O

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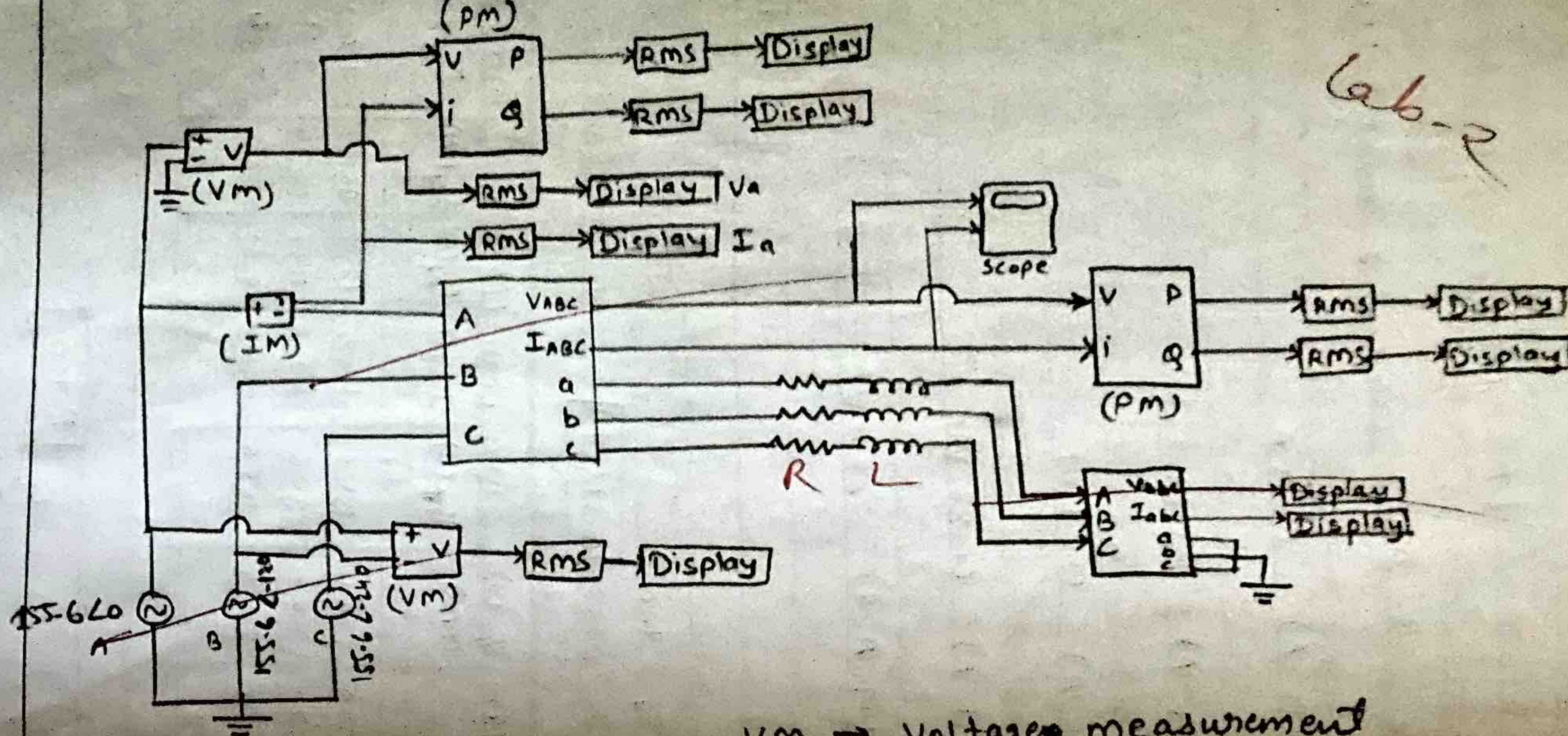
Lab-2



VM → Voltage measurement

PM → Power measurement

IM → Current Measurement

EXPT. NO. 3 NAME Page No. Date: 12/02/2024 YOUVA

Experiment-3

* Objective :- Design a circuit with ac source, series RLC Branch and a series RLC load and perform the following activities

(1) (2) → RLC Branch converted into RL branch and RLC load also converted into RL load after connecting it to AC source.

∴ For that $C = 0F$; $R = 50\Omega$; $L = 0.3H$ in RLC branch and capacitive reactive power = 0 VAR. -- and $V = 311$ V; $f = 50$ Hz

→ $L = 0.3H$ because $R \approx X_L$.

~~(3)~~ ~~f~~

(3) RMS ~~Voltage~~ Current $I_{rms} = 0.8223A = \dfrac{220V}{\underbrace{(R^2+X_L^2)^{1/2}}_{\text{Load}} + \underbrace{(R^2+X_L^2)^{1/2}}_{\text{Branch}}}$

(4) RMS voltage across source = 228.8 V

RMS Voltage across load = 114.2 V

(5) Power across load =>

Real power = 0.00125 Watt

Reactive power = -0.00119 VAR

Power across Source =>

Real power = 0.00135 Watt

Reactive power = -0.00055 VAR

$\boxed{\text{P.T.O.}}$

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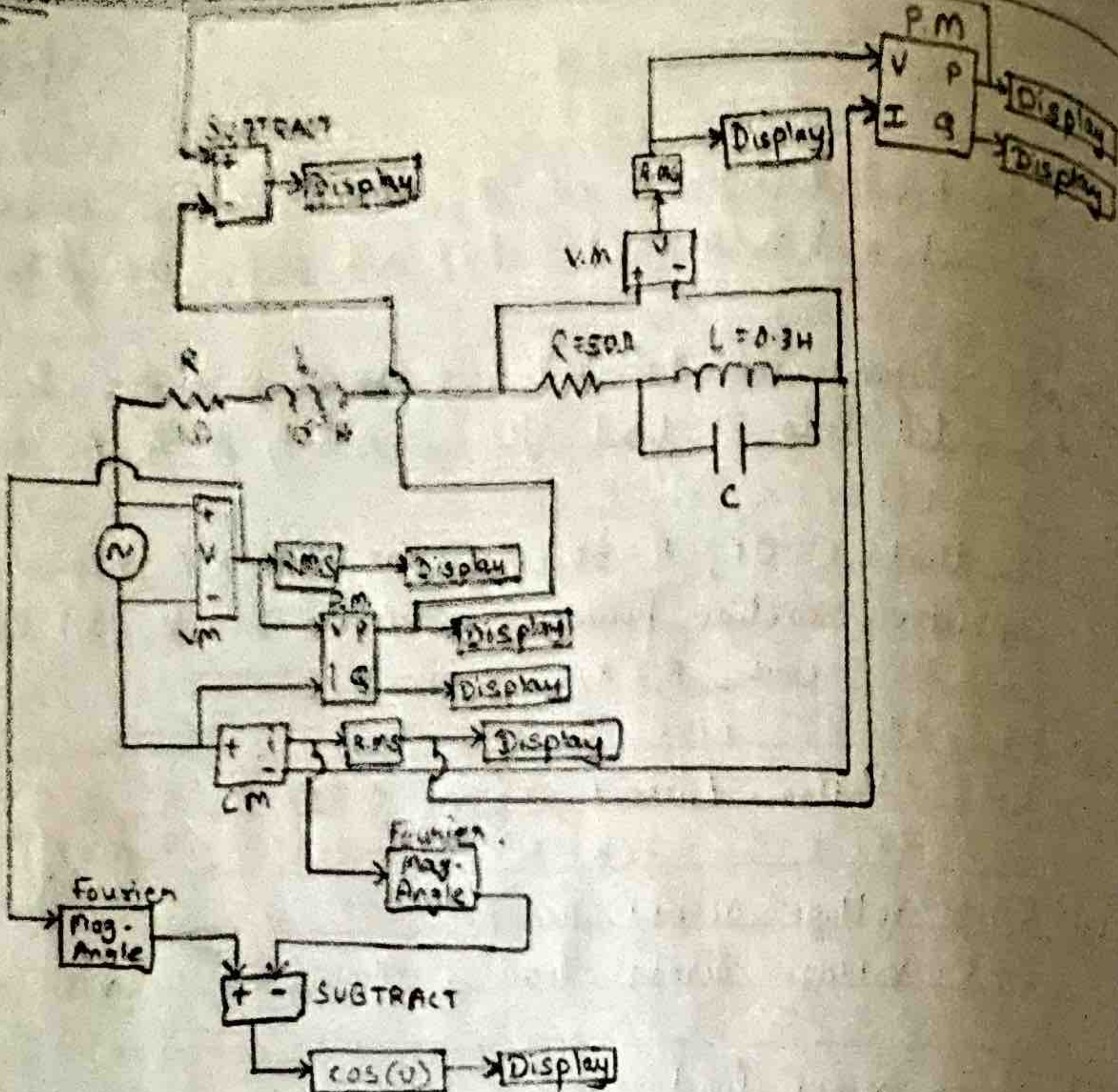
LAB-03



V.m → Voltage measurement.

A m → Current measurement.

P.m → Power measurement

→ Fourier gives the value of magnitude and angle to which it gets input connection. We feed the angles from current and voltage to the subtract and feed the difference of angle to function cos(U) to get the value of Power factor.

(6) Difference of the real power supplied to load from the source = -0.00100 Watt

(7) Power factor = $\frac{\text{real power}}{\text{apparent power}}$ = 0.9139.

(8) Values are noted above.

(9) After connecting capacitor of capacitance 0.1F power factor becomes 0.9585 lagging.

(10) Power factor increases. $V_{\phi RMS} = 228.8V$; $I_{RMS} = 0.8223$ A; $V_{Z RMS} = 114.4$ V ; $P = 2.65 \times 10^{-14}$ Watt ; $Q = 7.889 \times 10^{-12}$ VAR.

↳ Difference of the real power of load from source = -0.2489 Watt

Q11)

Sr. No.	Capacitance	Power-factor	
1]	0.5 F	0.999 lagging	
2]	0.8 F	0.9998 lagging	Inductive load
3]	1 F	1 lagging	
4]	5 F	1 laggins	
5]	0.01F	0.9487 lagging	
6]	For L = 0.7H and C = 0.001 F	0.2355 leading	← Capacitive load.

Q12) If capacitance increases, p.f. tends to unity (1), and power factor changes to leading if capacitance decreases and makes the load capacitive.

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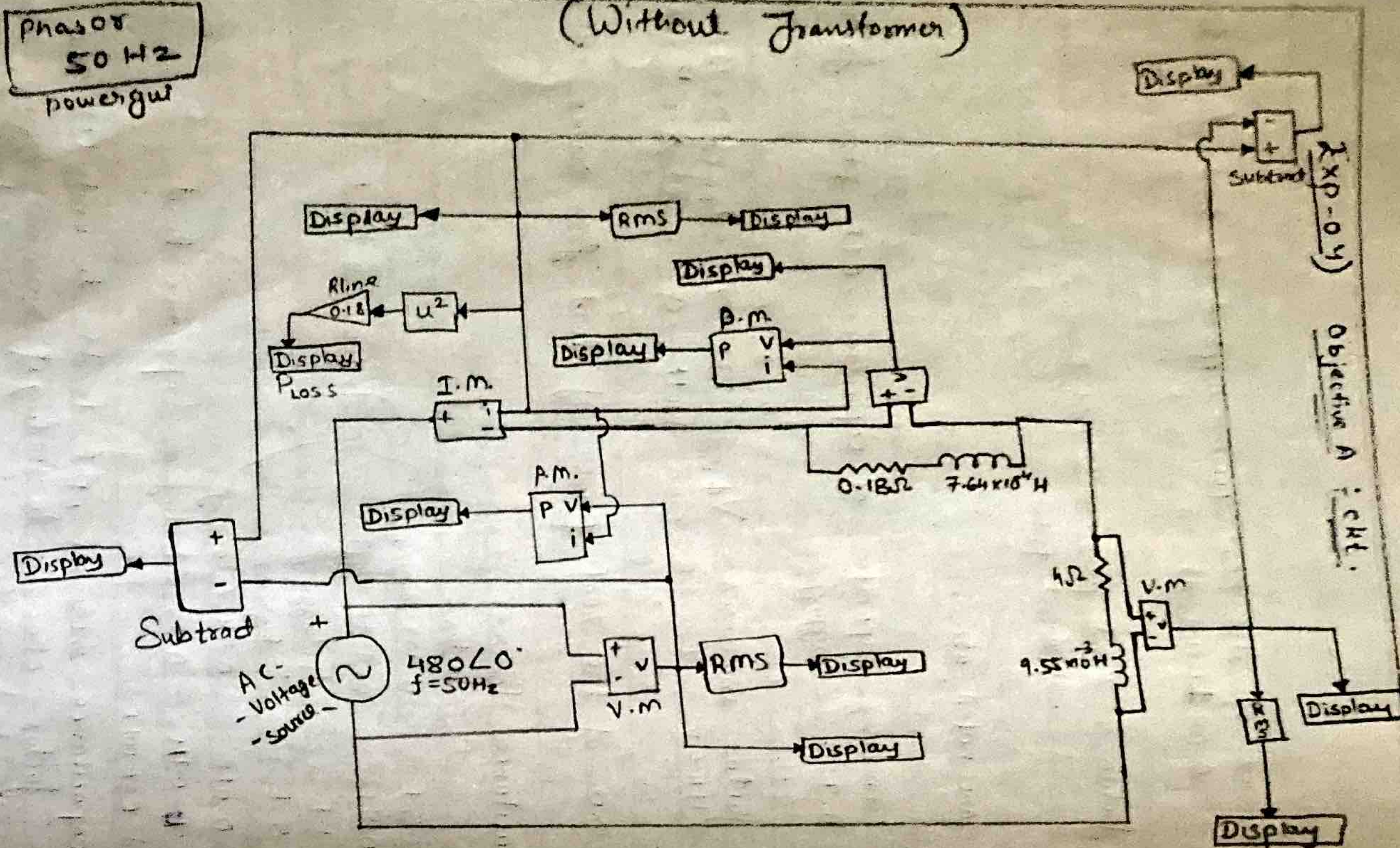
Exp-04) Objective A : ckt.

(Without Transformer)



P.M. → Power Measurement
V.M. → Voltage Measurement
I.M → Current Measurement

EXPT. NO | NAME

Experiment - 04

Objective : To observe the power loss in the transmission line when circuit connected to transformer-supply and when the supply is not through transformer

[A] ~~$Z_{load} = 4 + 3j \ \Omega$~~ $Z_{load} = 4 + j3 \ \Omega$

~~$Z_{line} = 0.18 + 0$~~ $Z_{line} = 0.18 + j0.24 \ \Omega$

$V = 480 \ V$

$f = 50 \ Hz$

(1) Magnitude of current and it's phase angle :

$$\boxed{I = 90.76 \angle -37.78 \ A}$$

(2) Magnitude of load voltage and phase angle :

$$\cancel{\boxed{V_L = 453.8 \angle +0.9101 \ V}} \quad \boxed{V_L = 453.8 \angle -0.9101 \ V}$$

(3) Phase difference between the load current and the load voltage

$$\cancel{= (-37.78 - (-0.9101))} \quad = (-37.78 - (-0.9101))$$

$$\cancel{= \boxed{36.87^\circ}} \quad = \boxed{-36.87^\circ}$$

(3) ~~(5)~~ Phase difference between line current and the source voltage:

$$= +(-37.78^\circ - 0^\circ) \ \cancel{= \boxed{+37.78^\circ}}$$

$$= \boxed{-37.78^\circ}$$

~~[6]~~

P.T.O

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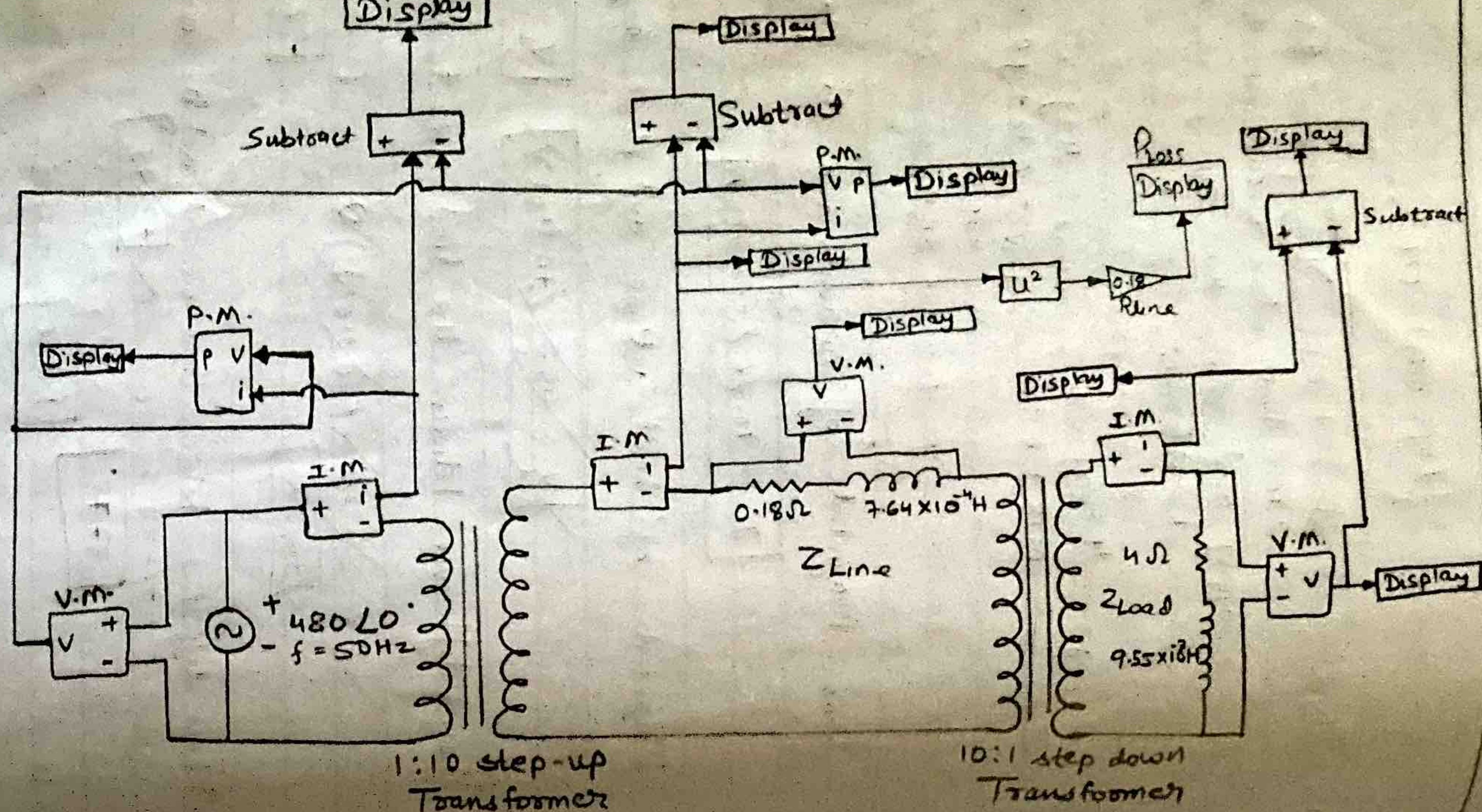
(With Transformer)

P.M. → Power Measurement
V.M. → Voltage Measurement
I.M. → Current Measurement



(5) Power loss in the transmission line : $\boxed{1483 \text{ Watt}}$

~~= 1506 − 8.075~~

~~= 142.505 Watt~~

(6) Voltage drop across the line impedance : $\boxed{27.23\ V}$

[B] Suppose a 1:10 step-up transformer is placed at the generator end of the transmission line and a 10:1 step-down transformer is placed at the load end of the line:

(1) Source current, $I_{source} = 95.28 \angle -37.47^\circ A$
Line current, $I_{Line} = 9.528 \angle -37.47^\circ A$
Load current, $I_{Load} = 95.21 \angle -37.46^\circ A$

(2) Load voltage, $V_{Load} = 476.1\ V \angle -0.5853^\circ$

(3) Phase difference between source current and source voltage $= (-37.47^\circ - 0^\circ) = \boxed{-37.47^\circ}$

(4) Phase difference between line current and source voltage $= \boxed{-37.47}$

(5) Phase difference between load current and load voltage $= \boxed{-36.87}$

(6) Power loss in the transmission line, $\boxed{P_{loss} = 16.34\ W}$

(7) Voltage drop across the line impedance, $\boxed{V_{line} = 2.85}$

EXPT. NO.	NAME	Page No.	
		Date	

[C] Observed difference of the power losses in the transmission line in the above 2 setups of the power system.

$$= (P_{Loss})_{\text{without transformer}} - (P_{Loss})_{\text{with transformer}}$$

~~= 1483 − 16.34~~
~~= 1466.66 W~~

~~= 142.505 − 16.34~~
~~= 126.165 Watt~~

$\Rightarrow 1483 - 16.34$

$= \boxed{1466.66 \text{ Watt}}$

→ Thus, we can see the use of transformers significantly reduces the power loss in the system.

X ——— X ——— X ——— X ——— X ——— X ———

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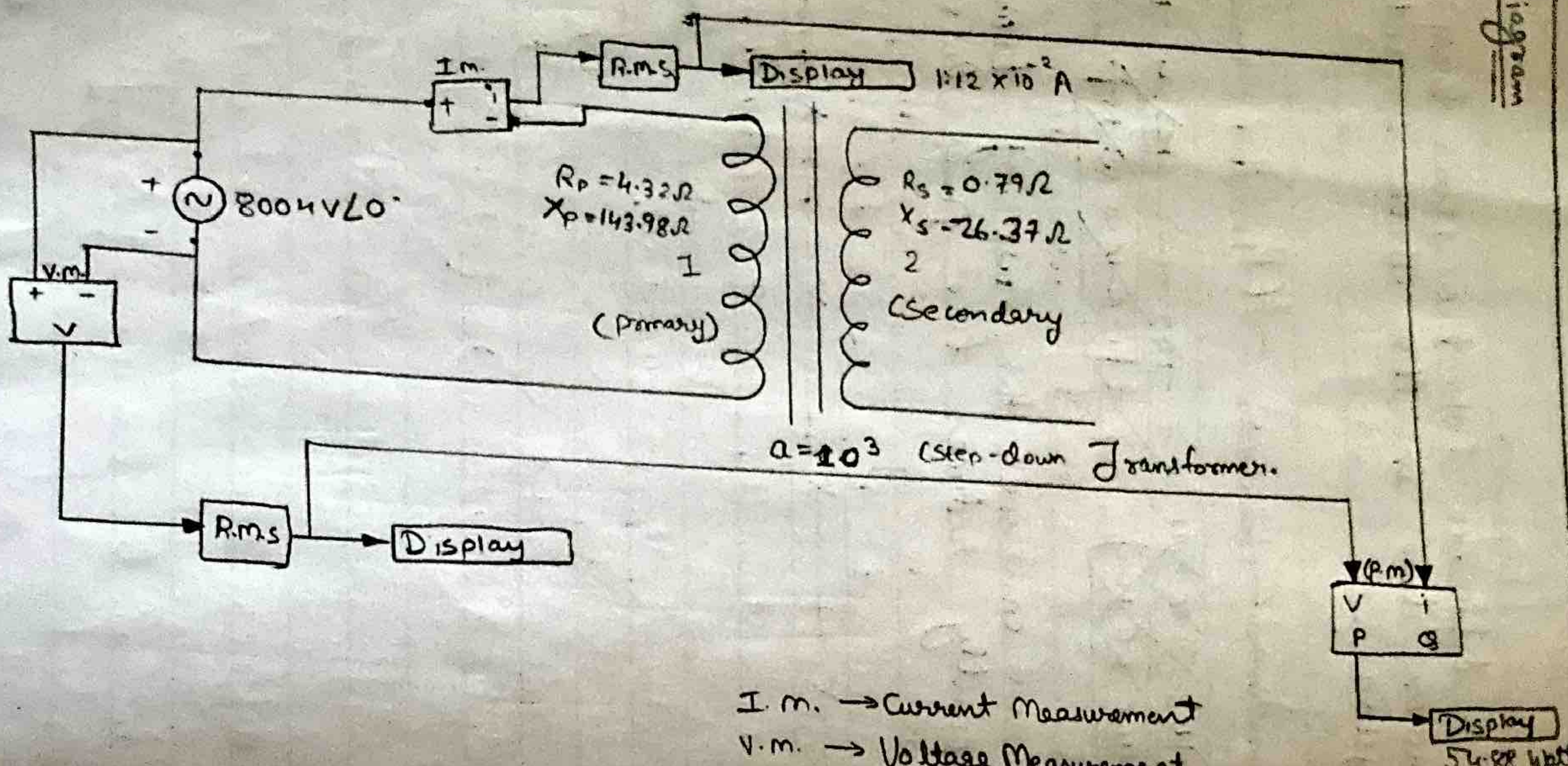
* Circuit Diagram

Continuous
powergui

Open Circuit Test



I.m. → Current Measurement
V.m. → Voltage Measurement
P.m. → Power Measurement

EXPT NO | NAME | Page no: | Date: | YOUVA

Exp- 05

[A] Connect a linear transfer to an A.C source. In addition connect the ammeter, voltmeter and power meter to ~~meas~~ measure and perform an open circuit test. With the measured values of V_{oc}, I_{oc}, and P_{oc}, determine.

(i) Core Resistance R_c

From Simulink: $\boxed{V_{oc} = 8004\ V}$

$$\boxed{I_{oc} = 1.12 \times 10^{-2}\ A}$$

$$\boxed{P_{oc} = 54.88\ Watt}$$

$\therefore$ We know; $P_{oc} = V_{oc} \cdot I_{oc} \cos\theta$

$$\therefore \theta = \cos^{-1}\left(\frac{P_{oc}}{V_{oc} \cdot I_{oc}}\right)$$

$$\therefore \theta = \cos^{-1}\left(\frac{54.88}{(8004)(1.12 \times 10^{-2})}\right)$$

$$\therefore \theta = \cos^{-1}(0.6121)$$

$$\therefore \boxed{\theta = -52.26}$$

$\therefore$ The admittance of the excitation branch:

$$Y_E = \frac{I_{oc}}{V_{oc}} \angle -52.26^\circ - \boxed{0.000204 \angle -52.26^\circ}$$

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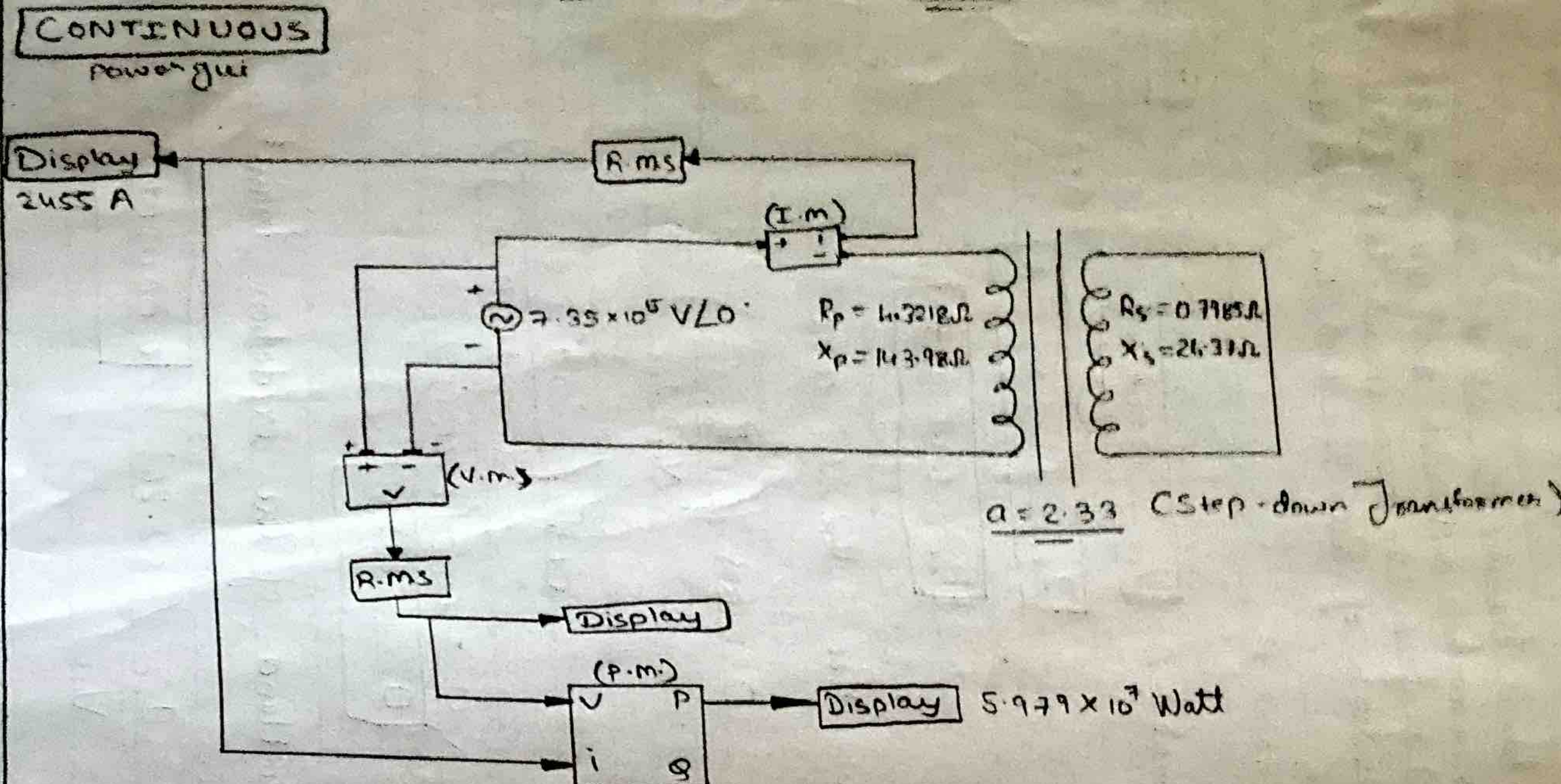
Short Circuit Test



$a = 2.33$ (Step-down Transformer)

P.m → Power Measurement
I.m → Current Measurement
V.m → Voltage Measurement

Converting Y_E into rectangular form :

$$\therefore Y_E = 2.04 \times 10^{-4} \left(\cos(-52.26) + j \sin(-52.26) \right)$$

$$= 2.04 \times 10^{-4} \left(0.612 + (-1) j (0.791) \right)$$

$$\therefore \boxed{Y_E = 1.25 \times 10^{-5} - j (1.61 \times 10^{-5})} = \frac{1}{R_C} - j \frac{1}{X_m}$$

$$\therefore R_C = \frac{1}{1.25 \times 10^{-5}} = \frac{100000}{1.25}$$

$$\therefore \boxed{R_C = 80 k\Omega}$$

$$\therefore X_m = \frac{1}{1.61 \times 10^{-5}}$$

$$\therefore X_m = 0.6211 \times 10^5$$

$$\therefore \boxed{X_m = 62.11 k\Omega}$$

→ Now in Simulink;

R_c of core $= 0.0804 \times 10^6 \Omega = \boxed{80.4 k\Omega}$ and;

X_m of core $= 197.80 \times 2 \times 3.14 \times 50$

$$= 62209.2 \times 10^0 = 62209.2 \Omega = \boxed{62.21 k\Omega}$$

[B] Short Circuit Test of Transformer

* To determine equivalent series resistance and equivalent ser reactance by using determined values of P_{sc}, V_{sc} & I_{sc}

1]. Equivalent series resistance
2]. Equivalent series reactance.

P.T.O

Teacher's Signature

[C] Estimation of Values of R_p, X_p, R_s, X_s :-

$\Rightarrow \boxed{R_p = 4.32\,\Omega}$ $\Rightarrow \boxed{R_s = 0.79\,\Omega}$

$\Rightarrow \boxed{X_p = 143.98\,\Omega}$ $\Rightarrow \boxed{X_s = 26.37\,\Omega}$

Open Circuit Test	Short Circuit Test
1) $I_{oc} = 1.12 \times 10^{-2}$ A	1) $I_{sc} = 2455$ A
2) $V_{oc} = 8004$ V	2) $V_{sc} = 7.646 \times 10^{5}$ V
3) $P_{oc} = 54.88$ Watt	3) $P_{sc} = 5.979 \times 10^{7}$ Watt
4) $\cos\theta = 0.6121$	4) $\cos\theta = 0.031$
5) $R_c = 80\,k\Omega$	5) $R_{eq} = 9.64\,\Omega$
6) $X_m = 62.11\,k\Omega$	6) $X_{eq} = 310.82\,\Omega$
	7) $R_p = 4.3218\,\Omega$
	8) $X_p = 143.98\,\Omega$
	9) $R_s = 0.7938\,\Omega$
	10) $X_s = 26.37\,\Omega$

$\therefore$ Measured value of $P_{sc} = 5.979 \times 10^7$ Watt

$\Rightarrow$ Measured value of $I_{sc} = 2455$ A

$\Rightarrow$ Measured value of $V_{sc} = 7.646 \times 10^5$ V

$\therefore$ We know that ; $\cos\theta = \dfrac{P_{sc}}{V_{sc} \cdot I_{sc}} = \dfrac{5.979 \times 10^7}{7.646 \times 10^5 \times 2455} = 0.031$

$\therefore \cos\theta = 0.031$

$\therefore \boxed{\theta = 88.22^\circ} \Rightarrow \boxed{\sin\theta = 0.999}$

$\therefore Z_{eq} = \left|\dfrac{V_{sc}}{I_{sc}}\right| = \dfrac{7.646 \times 10^5}{2455} = 311.44\ \Omega$

$\therefore Z_{eq} = \dfrac{V_{sc}}{I_{sc}} \angle 88.22^\circ = 311.44\cos\theta + j\,311.44\sin\theta$

$\therefore R_{eq} + j(X_{eq}) = 311.44\cos\theta + j(311.44)\sin\theta$

$\therefore R_{eq} = 311.44 \times 0.031 = \boxed{9.64\ \Omega}$ and $X_{eq} = 311.44 \times 0.999 = \boxed{310.8\ \Omega}$

$\rightarrow$ Now in Simulink;

$a = 2.33$; $a^2 = 5.42$

$\therefore R_{eq} = R_p + a^2 R_s = 4.3218 + 5.42 \times 0.7938$

$= 4.3218 + 4.3023$

$= \boxed{8.76\ \Omega}$

$\therefore X_{eq} = X_p + a^2 X_s = 2 \times 3.14 \times 50 \times 0.55027 + 5.42 \times 2 \times 3.14 \times 50 \times 0.1010$

$= 172.78 + 172.009012$

$= \boxed{334.78\ \Omega}$

X —— X —— X —— X —— X —— X —— X —— X

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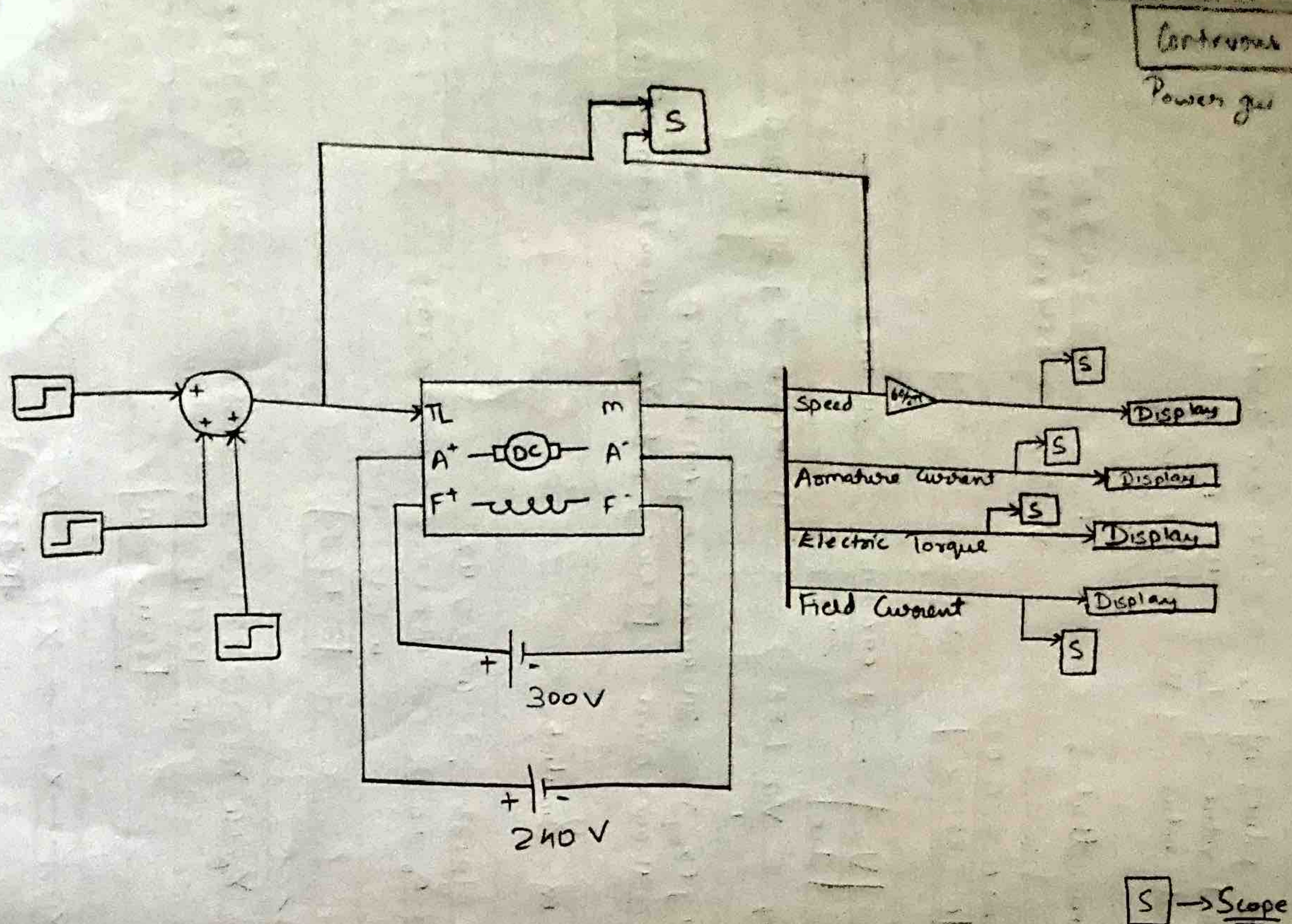
Continuous
Powergui
S
TL
m
A+
A-
F+
F-
DC
300 V
240 V
Speed
Armature Current
Electric Torque
Field Current
Display
Display
Display
Display
S
S
S
S
S → Scope

EXPT NO | NAME

LAB - 06

We take, 01, 5HP, 240V, 1750 RPM, Field; 300

→ Step 1; 2, 0, Full Load × 0.2

→ Step 2; 4, Full load × 0.2, Full load × 0.5

→ Step 3; 6, Full load × 0.5, Full load × 1

→ DC Source 1 = 240 V (Armature)

→ DC Source 2 = 300 V (Field)

→ Gain = 60/(2*π)

∴ Torque $= \dfrac{5 \times 746}{2\pi \times \left(\frac{1750}{60}\right)} = 20.35$ Nm

→ Output Power = $\boxed{5988 \text{ W}}$

→ Speed = $\boxed{1652 \text{ rpm}}$

→ Field current = $\boxed{1.067 \text{ A}}$

→ Armature ~~Curr~~ Current = $\boxed{25.18 \text{A}}$

→ Electric Torque = $\boxed{25.45 \text{ Nm}}$

∴ Input Power = (Field Voltage × Field Current + Armature voltage × Armature current)

$= 300\text{V} \times 1.067 + 240 \times 25.16$

$= \boxed{6358.5 \text{ W}}$

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$$\therefore \text{Efficiency} = \frac{5988\ W}{6358.5\ W} \times 100$$

$$\therefore \boxed{\eta_{efficiency} = 94.17\%}$$

—x——x——x——x——x——x——x——